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Page 1 of	27 Pages

SP600

Installation & Service Manual

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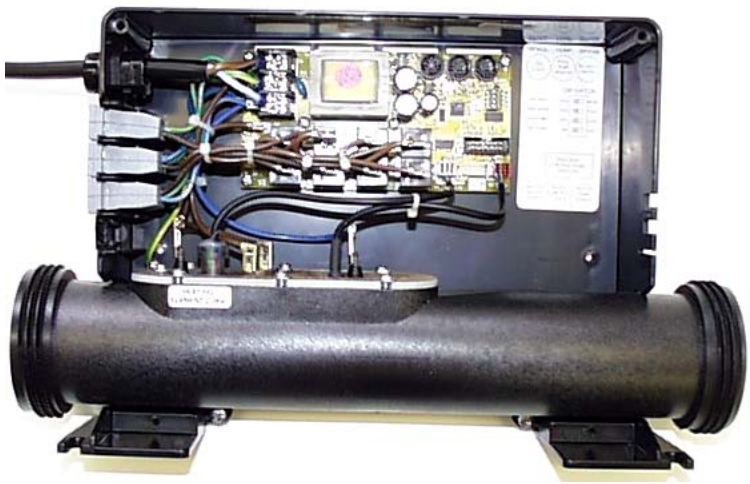
Contents

1 SP600 description

The SP600 is a microprocessor based spa pool controller capable of controlling the many features of an “intermediate” level spa pool. It offers the user complete control over the following via a poolside control panel.

- 1 or 2 speed circulation / jet pump (model dependant)
- Small 24 Hr circulation pump (model dependant) *
- Ozone *
- LED Variable colour pool light
- Aux pump, blower or variable speed blower
- Pool temperature
- Sleep time via a control box mounted clock
- Filtration cycle
- Clean up cycle

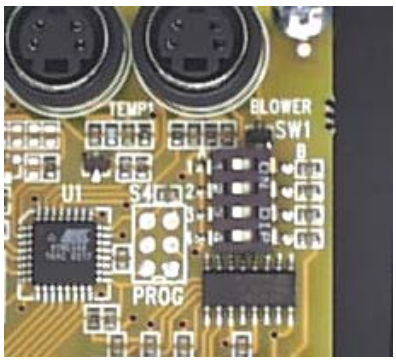


* These are controlled automatically so no user controls are provided.

Inside every SP600 is a 1.5kW or 2kW Flouropolymer coated element, an over temperature cut-out device, a temperature sensor, a water sensor, and a controller circuit board which includes an isolating transformer. All that is required to make the unit operate is a power connection and the digital LED switch (poolside control panel). In addition it must be plumbed into the pool and have a suitable pump connected which circulates water through the heater.

Initial set up of the unit is as simple as setting the target pool temperature. In addition, the unit’s sleep time, filtration function and heating mode can also be adjusted. Refer to the appropriate user guide for the model you are using. (See the appendix)

Further customisation of the unit can be achieved by adjusting the ‘Dip switch’ settings, which are located on the controller circuit board. Features such as load shedding (less / more), temperature sensor location (heater / pool), main pump (1spd / 2spd), circulation pump (none / fitted) can be altered at the flick of the appropriate switch. Refer to the installation guide in the appendix. These settings are normally factory set but sometimes the pool builder / installer may need to change them. The end user should not change them.



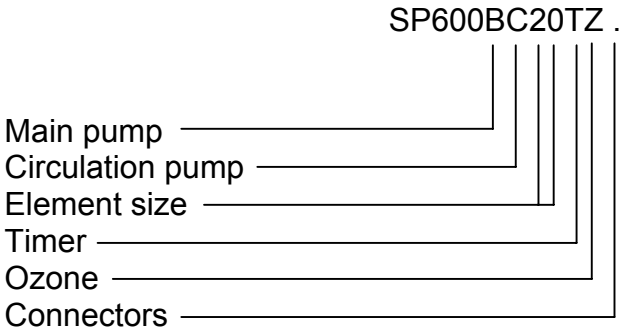
Each SP600 usually comes with a temperature sensor that is fitted to the heater assembly. Alternatively an optional in-pool temperature sensor can be fitted instead. The in-pool temperature sensor provides more accurate control of the pool temperature and is effected less by variations in operating conditions (See the temperature sensor section for more detail.) Both temperature sensors incorporate a solid-state digital sensor that is accurate to 0.5°C.

The water resistant poolside control panel features a polycarbonate overlay that is resistant to most chemicals. It contains an alarm beeper, soft touch keys and a three digit LED temperature display. All user controls are on this panel except sleep time adjustments, which can be done using the optional sleep control clock that may be fitted to the control box itself.

2 Model variations

The SP600 spa controller platform is very flexible and can be easily changed from one model to another by simply altering it's internal wiring and adjusting it's dip switches.

The SP600 model code is as follows:



Main pump
This is the pump that is connected to the pump outlet socket and controlled by the pump button on the touch pad. It is the pump normally used to power the pool's jets, and circulate water through the filter and heater. (unless a small circulation pump is fitted – see below)

A = single speed, B = two speed.

Small circulation pump
This is a small circulation pump (typically about 100W) that is used to run up to 24Hrs per day at a low flow rate (>20 L/m). It is plumbed to run water through the filter, heater and ozone system (if fitted).

C = Circulation pump outlet socket fitted. This is in addition to the main pump socket.

Element size
This indicates the element size in kilowatts (kW).

15 = 1.5kW, 20 = 2.0kW

Timer
The timer is a digital clock that is used to perform the sleep function of the system.

T = Timer fitted.

Ozone
A power outlet for an ozonator is provided.

Z = Ozone outlet socket fitted. This is in addition to all other sockets.

Connections
Generally, J&J connectors are provided for all power outlets. However, other options are possible.

Blank = J&J, G = gland.

Examples of possible SP600 systems….
SP600A15, SP600AC15, SP600AC15T, SP600AC15TZ, SP600A15TZ, SP600AC15Z
SP600A20, SP600AC20, SP600AC20T, SP600AC20TZ, SP600A20TZ, SP600AC20Z
SP600B15, SP600BC15, SP600BC15T, SP600BC15TZ, SP600B15TZ, SP600BC15Z
SP600B20, SP600BC20, SP600BC20T, SP600BC20TZ, SP600B20TZ, SP600BC20Z

All models have at least two outlet sockets - pump and aux. If the model includes the circulation and/or ozone options then the unit will have suitable additional outlet sockets. For example a SP600BC20TZ will have four outlet sockets: Pump, Aux, Circ, and Ozone. A SP600B20TZ will have three: Pump, Aux, and Ozone sockets.

A & B models.
The SP600 PCB has only four relays that provide the following functionality.

Relay	'A' models	'B' models
K1	Safety	Safety
K2	Aux	Pump - high
K3	Pump	Pump - low
K4	Element	Element

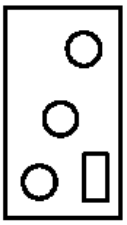
The safety relay is used to switch off all loads should there be a fault in the system. In addition the safety relay is also turned off (SP600 'C' models) when the unit is in sleep mode. This turns off the small circulation pump and ozone unit in order to reduce their run times.

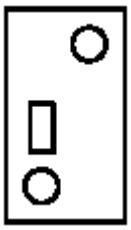
AUX outlet
The table above shows that relay K3 is used to switch the Aux load in 'A' models and the high speed of a two-speed pump in 'B' models. In 'B' models the Aux socket is connected to the safety relay and is on at all times unless there is a fault in the system or it is asleep (SP600 'C' models). A blower can be connected to a 'B' model but it must be a 'Spa Power Variable Speed Blower (SPVSB)'. These blowers contain all the required circuitry to turn on the blower and regulate it's speed and are controlled by the SP600 via a control lead that plugs into the SP600 PCB. If a standard on/off blower is plugged into a 'B' model it will operate continuously unless the SP600 faults (or goes to sleep for SP600 'C' models).

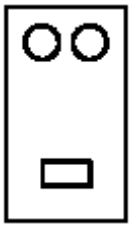
Circulation outlet
The circulation pump socket is fed from the safety relay and is therefore on unless the system faults or is asleep. ('C' models)

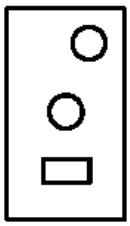
Ozone outlet
The Ozone socket is wired so that it comes on with the pump that is used to perform the pool's filtration and so it is wired differently depending on the model. On 'A' and 'B' models the ozone is wired so that it comes on with the pump (low speed on 'B' models). On 'AC' and 'BC' models it is wired so that it comes on with the circulation pump. See the appropriate wiring diagram in the appendix.

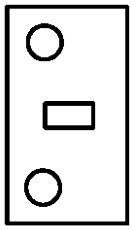
J&J outlet sockets
The following diagrams show the required J&J for each outlet function.


2spd pump


1spd pump


Aux


Circ


Ozone

2.1 User guide

Refer to the relevant "SP600 user guide" in the appendix for complete instructions. There are two different user guides provided to cover the SP600 range. The differences between the user guides are related to the pump configuration.

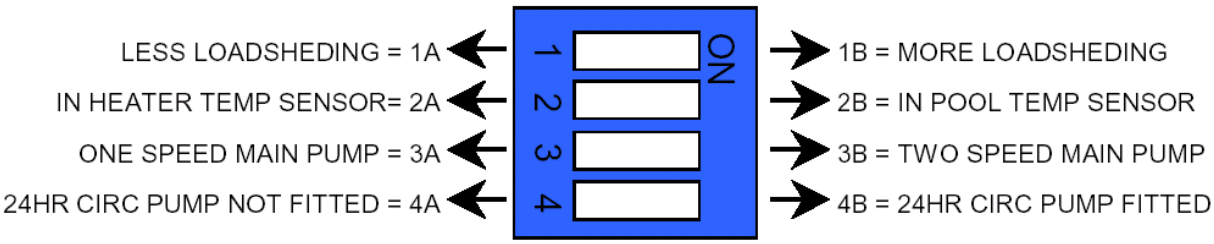
The two user guides are:

SP600 User Guide for 'A' & 'B' models
SP600 User Guide for 'AC' & 'BC' models

2.2 Installation Guide

Refer to "SP600 installation guide" in the appendix for complete instructions.

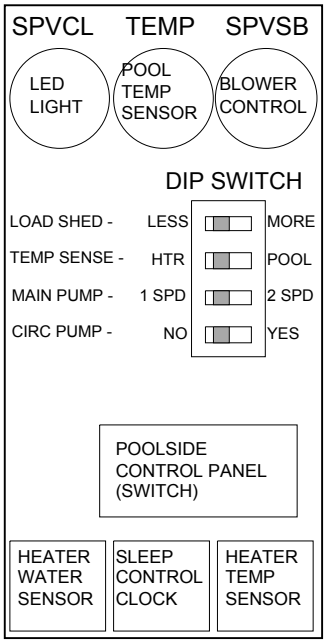
Dip switch settings



PCB sockets

There are three round "mini-din" connectors situated at the top right of the SP600 PCB. They are provided so that optional equipment (SPVCL, temp sensor, SPVSB) may be connected to the system during installation or at a later date. It is important that the power to the SP600 be disconnected when connecting or disconnecting any peripheral equipment to reduce ESD or transient damage to the equipment and also to reduce the risk of electrocution.

Note that only one temperature sensor should be connected at any time. Either a 'in-heater' temp sensor or an 'in-pool' temp sensor but not both at the same time.



2.3 SP600 Specifications and Outlet loading

	Specifications	
	SP600 dimensions	360mm x 220mm x 95mm
	Heater tube pipe diameter	50mm
	Heater pressure, max (head of water)	300kPa (30m)
	Temp – max controlled	41.5°C
	Temp – thermal cut out	50°C +/- 3°C
	Temp – max ambient	40°C
	Mains cord length	5m
	Pool side touchpad – face	118mm x 65mm x 6mm
	Pool side touchpad – body	92mm x 40mm x 17mm
	Recommended switch hole	94mm x 42mm
	Switch lead length	3m
	Supply requirements (Max total loading)	
	1.5kW models	220-240V, AC, 50-60Hz, 10A
	2.0kW models	220-240V, AC, 50-60Hz, 15A
	Max Outlet Loading 1.5kW	
	Pump socket	220-240V, AC, 50-60Hz, 3.7A
	Aux socket	220-240V, AC, 50-60Hz, 6.3A
	Circ	220-240V, AC, 50-60Hz, 2.0A
	Ozone	220-240V, AC, 50-60Hz, 0.5A
	Max Outlet Loading 2kW	
	Pump socket	220-240V, AC, 50-60Hz, 6.7A
	Aux socket	220-240V, AC, 50-60Hz, 8.3A
	Circ	220-240V, AC, 50-60Hz, 2.0A
	Ozone	220-240V, AC, 50-60Hz, 0.5A

To prevent early system failure the sum of the outlet loadings and heater at any time should not exceed the 'Max total load'. See 'Loading calculations' to check the system in question.

3 General installation instructions

3.1 Plumbing

1. The heater should be plumbed so the water flows past it from left to right when horizontally mounted and bottom to top when vertically mounted (with the water sensor at top).
2. When connecting pipework to the heater make sure the 'O' rings are properly seated in the mac union fitting. Hand tighten only. Using tools will distort the fittings.
3. Make sure the controller is mounted securely so that vibration is minimised.
4. It is recommended that the pipework has shut off valves so the controller can be removed for service without loss of water.
5. Pressure test the installation to check for leaks.
6. Strap all pipework to prevent sagging and to prevent movement when pumps turn on or off.
7. Insulate all pipework to decrease heat loss.

Refer to the ‘Circulation pump’ & ‘Ozone system’ sections of this manual for information regarding the installation of those systems.

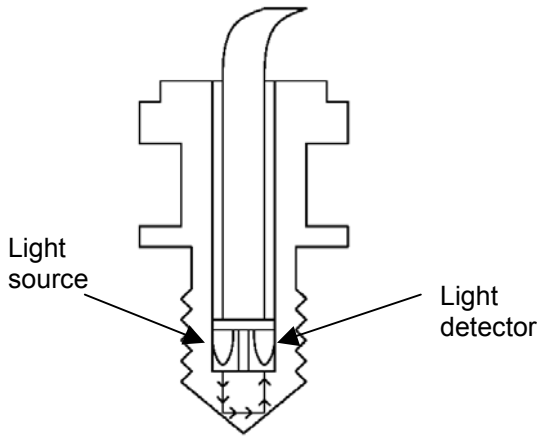
3.2 Electrical

1. The spa pool must be connected to a suitable weather protected supply, equipped with a double pole isolating switch, which is of the correct rating and complies with the local wiring regulations. When installing refer to your local wiring code. In particular refer to ECP2 and ECP25 (AS / NZ). Or EN 60364-4-1 and EN 60364-7-1 (EU). The system must be installed in such a way that live parts are not accessible by a person in the pool.
2. It is recommended that signal and power wiring be separated to prevent interference and that the unit is supplied from a dedicated power circuit.
3. Loop wires before they enter the unit to prevent water running down them and into the unit.
4. Check all connections are correct and tight.
5. Check that the unit and supply are not overloaded. See ‘Loading calculations’ for details.

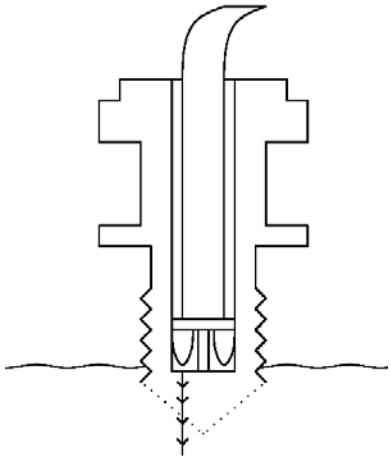
4 System components

4.1 Water detection

A water detection system is used to tell the controller when the heater tube is flooded with water and therefore when it's safe to turn the element on. Water detection is achieved by optical means in all SP600 models where by an optical bolt (water sensor) is mounted in the element assembly. Inside the optical bolt is a light source and a light detector.



When the tip of the optical bolt is surrounded by air the light emitted by the light source is reflected back to the light detector as the tip acts like a mirror.



The mirroring effect of the tip is lost once submerged and the detector receives no light.

The optical bolt has many advantages over traditional pressure switches and flow switches as there are no moving parts or adjustments required. Once installed, it is very robust and offers a long service life. The optical bolt is also less sensitive to collecting hair and debris. However care must be taken to ensure that air is not trapped in the heater tube during normal operation. This is especially important when low flow rate pumps (e.g. light circulation pumps) are used as they do not produce sufficient water flow to clear air from the heater tube. See the 'Circulation pump' section for more information.

The water sensor is connected to the SP600 PCB. Additional circuitry is included on the PCB to check that the water sensor is connected and is functioning correctly.

4.2 Thermal cut-out

Each SP600 contains a thermal cutout device (also known as a klixon). It is an electro-mechanical device that acts like a switch. When it is heated above 50°C +/-3°C it switches off creating an open circuit. When it cools below 38°C it switches on and creates a short circuit.

It is placed in series with the heating element and tightly coupled (thermally) to the brass element boss. The element will then be switched off if the brass element boss gets too hot.

There is also an associated electronic detection circuit that is used to sense if power is getting to the element. If the thermal cutout has operated the circuit will sense a lack of power and the controller will fault (Error 6). The controller will not attempt to recover from this condition, it will need to have the power turned off and back on again to clear the fault once the thermal cutout has cooled.

4.3 Temperature sensor

The SP600 comes with a temperature sensor built into the element assembly. It is a digital sensor that is accurate to 0.5°C and it talks to the controller via a data link. It is housed in a tubular pocket that extends into the heater tube's water flow. The temperature sensor is sealed into the pocket and plugs into the SP600 PCB. This sensor configuration is known as 'in-heater' temperature sensing.

'In-heater' temperature sensing is the most convenient method of sensing the pool's water temperature as it is built into the controller, however it is not the most accurate. It will generally provide good temperature regulation of the pool if used in conjunction with a high flow rate pump and good pool insulation.

A large hysteresis is required if demand heating is used. Demand heating is where the pump and element are turned on when the sensed temperature is below the target temperature and turned off when up to temperature. A large hysteresis is required because the water in the heater will cool down, when the pump is off at a different rate to the main body of water in the pool. If the pipe work is poorly insulated the system can cycle rapidly (thermally) resulting in the pump & element turning on and off frequently thus shortening equipment life and irritating the user. Then again if the pipe work or pool cabinet is well insulated so the heater does not cool down much below the pool temperature it can result in poor temperature control of the pool.

A better method exists. It is called 'in-pool' temperature sensing. In this method a temperature sensor is mounted in the pool shell so that it is able to directly sense the pool water. This is a far more accurate method. It allows the use of tighter hysteresis in the temperature control software and is much less affected by differing insulation designs and ambient temperatures.

'In-pool' temperature sensors use the same digital temperature sensing device as the 'in-heater' sensors. For accurate sensing of the pool water the digital sensor in the 'in-

pool' sensor needs to be tightly coupled (thermally) to the pool water and insulated from any other ambient temperature effects i.e. under skirt ambient. This is achieved by mounting the sensing device to a stainless steel disk and then packing the case of the sensor with insulation. Additional closed cell foam insulation (supplied) must then be placed around the sensor when mounted in place.

The SP600 can only be connected to one temperature sensor at any time. The controller will fault if both the 'in-pool' and 'in-heater' temperature sensor are connected to the pcb.

4.4 Spa Power Variable Colour Light (SPVCL)

All SP600 models can power one 'Spa Power Variable Colour Light' (SPVCL). The SP600 will automatically sense that a light has been plugged in and will make the light functionality available on the touch pad and will also enable Aux load shedding when the light is on. (A & AC models only)

Aux load shedding is enabled when the light is operated so that the 12V power supply is not overloaded. The light draws the same current as one of the four SP600's relays, turning the auxiliary relay off when the light is activated keeps the 12V power supply in regulation.

Utilising the latest in efficient LED lighting technology the SPVCL offers long life and a range of vibrant colours to make any pool look stunning. The SPVCL simply plugs into any of the latest Spa Power range of controllers and is then controlled via the controller's poolside touchpad, making it a perfect accessory. The range of colours and modes of operation are dependant on the controller (see the SP600 user instructions in the appendix). Installation is as per a standard 2.5 inch pool light.

Features

- Energy efficient design. Maximum 12V current drawn is less than 0.07A
- Typical LED life of 50 000hrs to 100 000hrs compared to a normal incandescent bulb life of between 5 000hrs to 15 000hrs.
- Energy efficient design means the SPVCL runs far cooler than a normal bulb
- Perfectly matched primary colours support smooth colour mixing
- Light output exceeds that of a typical 9W bulb using filter lenses

4.5 Spa Power Variable Speed Blower (SPVSB)

All SP600 models can control one 'Spa Power Variable Speed Blower' (SPVSB). The SP600 will automatically sense that a SPVSB has been plugged in and will make the variable speed functionality available on the touch pad.

SP600 'A' models can operate either a standard on/off blower or the SPVSB. SP600 'B' models can only operate the SPVSB. Refer to 'Model Variations' for more details.

The cleverly designed SPVSB has been produced to accompany the latest Spa Power range of controllers or to be used as a stand-alone unit. It contains all the required speed control circuitry and simply plugs into a controller or it's very own poolside

touchpad. When used with a controller the SPVSB is controlled via the controller's poolside touchpad. In either configuration the user can control the airflow in the pool simply by pressing a button.

SPVSBs are available with or without a fitted power supply. Those without are intended for use only with a Spa Power controller to help minimise overall system cost. Where as those with a power supply can be used either with a controller or in the stand-alone configuration.

4.6 Circulation pump

The use of small circulation pumps that run for long periods of time with low flow rates is becoming more common in the pool industry. These pumps are used to circulate water through the pool's filter, heater and ozone systems and promise low power usage and silent operation. They are generally between 80W to 200W and have flow rates of greater than 20 l/m.

The SP600 'C' models have been designed to be used with circulation pumps but care must be taken to ensure that the following points are considered.

1) Air must not collect in the heater tube.

Any air trapped in the heater tube may be sensed by the water detector causing the controller to think the heater tube is empty and resulting in it faulting with 'H20'. Also froth in the heater tube may still activate the water sensor while failing to cool the element boss, resulting in thermal cut-out operation (error 6).

2) There must be greater than 20 L/m flow rate through the heater tube.

When the element is on it uses electrical power to heat the water. Water flowing through the tube is therefore warmed and the resulting increase in temperature is termed the water's temperature rise.

If the water flowing through the tube is travelling slowly it will have a greater temperature rise than if it were moving fast, ie the faster the water flow the more water there is to absorb the element's energy.

If the water is not flowing through the heater tube fast enough then the heat energy will build up in the water and will lead to large temperature rises and at worst will cause the thermal cutout to activate. This will lead to an error 6 condition and the controller will beep. The controller will then need to be switched off and back on once the heater tube water temperature has dropped below 38°C. The thermal cutout will automatically reset below this temperature.

The thermal cutout is set to operate at 50°C +/- 3°C. This gives a maximum heater tube water temperature of 47°C. If the pool is set to 41.5°C then there is room for a maximum water temperature rise of 5.5°C. From this data a minimum flow of 20 L/m has been set. Flow rates of less than this can lead to thermal cutout operation.

Heating water with low flow rates also leads to the layer of water in contact with the element to boil. As the water boils it changes state and produces bubbles. These

bubbles must be able to escape from the heater tube or they will gather and finally be detected by the water sensor.

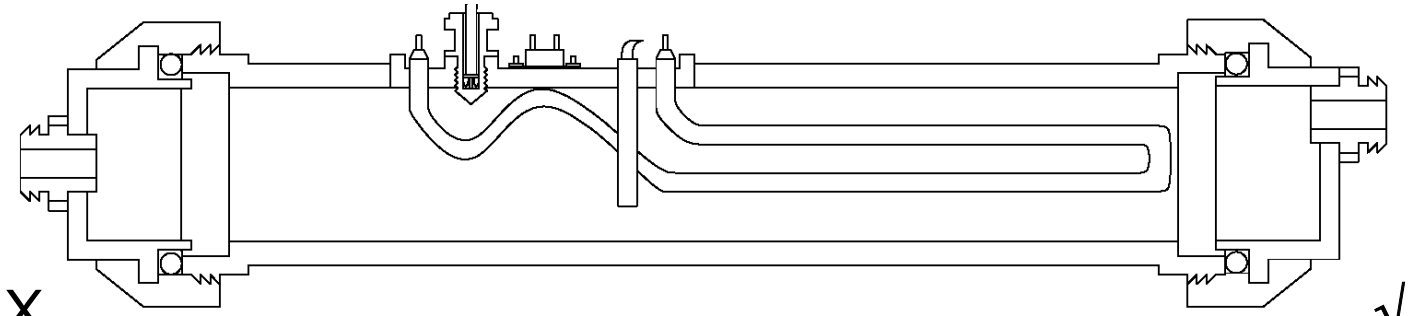
Due to the temperature rise caused by low flow rates it is advised that the 'in-heater' temperature sensor be unplugged from the PCB and that an 'in-pool' temperature sensor be used. This will provide the required accurate temperature control of the pool.

When using an injector to introduce ozone gas into the circulation pump's water circuit it is necessary to consider the water flow rates, both in the heater tube and the ozone injector. It is also important to situate the injector 'down stream' of the controller for air bubble reasons. See 'Ozone systems' for more detail. In order to maintain sufficient water flow it is recommended that an injector bypass system be implemented.

SP600 plumbing with circulation pumps.

It is essential that no air bubbles can collect in the heater tube.
The following plumbing configurations have proven to be helpful.
1) Use step down offset adapters from 50mm to 19mm, like that shown on the right hand side of the diagram below, do not use those shown on the left. This will allow any air to flow out of the heater tube and not collect around the water sensor or…
2) Mount the SP600 on it's side so that the heater tube is vertical with the water sensor at the top. This will allow the SP600 to detect if the heater tube is empty and also will eliminate problems caused by air collection. The water must pass from the bottom of the heater tube to the top in this configuration.
3) This is a mixture of 1 & 2 above. Mount the SP600 on a slight incline so that the water outlet is raised. This will aid the air to flow out of the heater tube.
4) Plumb the SP600 with 45° or 90° 50mm elbows (facing up) then step the pipe down to the required diameter.

Sectioned drawing of a heater tube with two different outlet adapters



X √

Other circulation pump tips

- Like all equipment, circulation pumps have a limited service life that is affected by the environment that it works in. If a pump is used 24hrs/day it will wear out faster than if it were used 12hrs/day. On SP600 'C' models the circulation pump is turned off when the system is asleep. This feature may be used to extend the circulation pump's life.
- Circulation pumps are designed for low flow rates so they have small impellers that are easily blocked. Be careful not to allow debris to enter the pump when changing a filter or use the pump without a filter.
- Due to low flow rates it is recommended that a skimmer type spa filter be used to allow the pump to remove floating matter from the pool's surface.
- Make sure the pump is not starved for water flow or is able to air lock.
- When using a Spa-Quip micro jet as the pool return, drill out its centre using a 12mm drill bit. This will increase its flow rate.

4.7 Two speed pump

SP600 'B' models are designed to operate two-speed pumps. But they must have the correct dip switch settings so that the unit knows that it is operating a two-speed pump. See the installation instructions in the appendix for correct dipswitch settings.

The SP600 'B' model will always start the pump in high speed for a second and then swap to low speed. This is because some pumps may not start on low speed but can stall and cause problems. If a two speed pump connected to a SP600 'B' is not starting correctly then check the dipswitch settings. SP600 'B' models use the low speed of the pump to perform the pool's filtration. (A SP600 'BC' uses a circulation pump.)

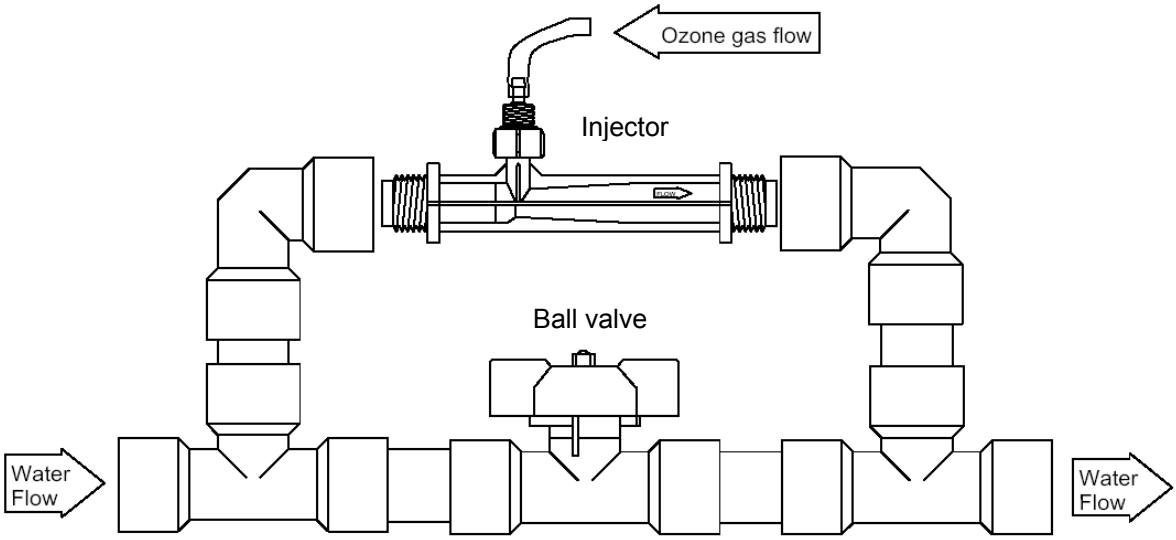
4.8 Ozone systems

SP600 'Z' models are equipped with an ozonator outlet socket. This socket is turned on when the main filtration pump is operating. This will provide ozonation of the pool water during the filtration period. See 'Model Variations' for more details.

Ozone background information

- Ozone does not affect the pH balance.
- Ozone reduces total dissolved solids in water.
- Ozone helps to reduce the amount of chemicals required to treat a pool.
- Ozone kills bacteria, viruses, cysts, yeast, molds, and mildew.
- Ozone is a gas that is generated from fresh air and is dissolved into the pool water.
- Ozone has more oxidising potential than chlorine gas and bromine.
- Ozone can be generated by UV light or corona discharge (CD). Corona discharge uses a high voltage to produce a spark. Generally CD ozonators produce more ozone than UV ozonators. Both types have a limited service life.

When using an injector to introduce the ozone gas into the water it is recommended that a water by-pass be used in parallel to the injector. A by-pass will allow the water flow rate through the injector to be tailored by adjusting the ball valve so that the correct ozone gas flow and therefore gas to water mixture is delivered. It will also ensure the water flow rate through the heater is maximised. Refer to your ozonator's installation instructions for more information.



The best use of any generated ozone gas is to dissolve it into the water and try to keep it dissolved in the water as long as possible.

Tips:

- A low injector water flow rate produces a low gas flow rate and results in higher ozone gas concentration and better ozone absorption into the water.
- Also a low injector water / gas flow rate produces small fine bubbles that are suspended in the water. This is better than large bubbles that rise straight to the pool's surface and let the gas escape.
- Ozone production is dependant on the condition of the air fed into the ozonator. Try to keep the air clean, dry and cool. I.e. pipe the ozonator's input air from outside the spa shell.
- Be careful of ozone when in the gaseous state as it will damage unsuitable plastics very quickly.
- Ozonators (UV and CD) have a service life. This can be prolonged if they are not used 24hrs a day. Most CD systems producing 50mg/hr of ozone gas need to run for about 4-8hrs per day at most to treat the water.
- Some ozonators require a minimum air flow rate to cool the ozone unit. Refer to your ozonator's instructions for more detail. (Some ozonators require the injector to produce a slight suck when blocked off with a finger. Others require a specific flow rate that can be estimated by timing the injector sucking water out of a bottle.)

5 Loading calculations

To prevent early system failure the sum of the outlet loadings and heater at any time must not exceed the 'Max total load' for that system. It is the pool builder / installer's responsibility to select suitable loads and system settings so as to avoid overloading the system or supply and to ensure the supply wiring etc is correctly rated.

In addition to outlet loadings the pool builder / installer must also take into consideration pipe diameter, system pressures and component ratings (pumps, blowers, lights, jets…) to ensure long pool life and reliability.

It is possible to configure the SP600 models as 10A or 15A systems by correctly selecting the heater element size and other loads and enabling the correct load shedding scheme.

The following tables show which loads are switched on in various operating modes with different load shedding options. These tables can be used as worksheets to calculate the total load of a given installation. Enter the load current in the white spaces and add up the columns to find the total system load. Calculated totals should be checked by measurement of an actual pool.

SP600 total loading calculations – 'A' models.

Dip switches																					
2 spd pump		0 (single speed)					0 (single speed)					0 (single speed)					0 (single speed)				
Load shedding		0 (none)					1 (aux AND pump(L))					0 (none)					1 (aux AND pump(L))				
circ		0 (none)					0 (none)					1 (fitted)					1 (fitted)				
Loads connected																					
Heater		1					1					1					1				
Pump (L)		1					1					1					1				
Aux / Pump(H)		1					1					1					1				
SPVCL		1					1					1					1				
Circ pump												1					1				
Ozone		1					1					1					1				
Mode		Auto	Pump on	Aux on	Pump & Aux	Pump, Aux SPVCL	Auto	Pump on	Aux on	Pump & Aux	Pump, Aux SPVCL	Auto	Pump on	Aux on	Pump & Aux	Pump, Aux, SPVCL	Auto	Pump on	Aux on	Pump & Aux	Pump, Aux, SPVCL
Load current	(A)																				
Pump (L)																					
Aux / Pump(H)																					
Heater																					
Circ pump																					
Ozone																					
Total load																					

SP600 total loading calculations – 'B' models.

Dip switches																					
2 spd pump		1 (two speed)										1 (two speed)									
Load shedding		0 (pumpH AND SPVSB)										1 (pumpH OR SPVSB)									
circ		0 (none)										0 (none)									
Loads connected																					
Heater		1										1									
Pump (L)		1										1									
Pump(H)		1										1									
SPVCL		1										1									
SPVSB		1										1									
Circ pump																					
Ozone		1										1									
Mode		Auto	Pump (L)	Pump (H)	SPVSB	Pump (L) & SPVSB	Pump (H) & SPVSB	Pump (L), SPVCL	Pump (H), SPVCL	Pump (L), SPVSB & SPVCL	Pump (H), SPVSB & SPVCL	Auto	Pump (L)	Pump (H)	SPVSB	Pump (L) & SPVSB	Pump (H) & SPVSB	Pump (L), SPVCL	Pump (H), SPVCL	Pump (L), SPVSB & SPVCL	Pump (H), SPVSB & SPVCL
Load current (15A System)	(A)																				
Pump (L)																					
Pump(H)																					
Heater																					
SPVSB																					
Circ pump																					
Ozone																					
Total load																					

SP600 total loading calculations – 'B' models continued.

Dip switches																						
2 spd pump		1 (two speed)										1 (two speed)										
Load shedding		0 (pumpH AND SPVSB)										1 (pumpH OR SPVSB)										
circ		1 (fitted)										1 (fitted)										
Loads connected																						
Heater		1										1										
Pump (L)		1										1										
Pump(H)		1										1										
SPVCL		1										1										
SPVSB		1										1										
Circ pump		1										1										
Ozone		1										1										
Mode		Auto	Pump (L)	Pump (H)	SPVSB	Pump (L) & SPVSB	Pump (H) & SPVSB	Pump (L), SPVCL	Pump (H), SPVCL	Pump (L), SPVSB & SPVCL	Pump (H), SPVSB & SPVCL	Auto	Pump (L)	Pump (H)	SPVSB	Pump (L) & SPVSB	Pump (H) & SPVSB	Pump (L), SPVCL	Pump (H), SPVCL	Pump (L), SPVSB & SPVCL	Pump (H), SPVSB & SPVCL	
Load current (15A System)	(A)																					
Pump (L)																						
Pump(H)																						
Heater																						
SPVSB																						
Circ pump																						
Ozone																						
Total load																						

Note -

Use the flowing tables to estimate the current of the pump, aux or element based on the electrical horse power (hp) or wattage (kW) rating. (Current = power / voltage, where 1hp = 745.7W or 0.7457kW, use 240V)

Note that some pumps, blowers or other loads are rated on mechanical or shaft power, this is not the same as electrical power as inefficiencies of the motor are not included. For example a 2.5hp (shaft) pump that is 70% efficient will draw approximately 2.5hp / 0.7 = 3.57hp electrical power. Also be aware that some loads draw up to 7 times their running current when starting, ie a 1hp pump draws 3.1A when running but approximately 21.7A when starting up. SP600 units have been designed to cope with this brief overloading.

If in doubt about a load's current draw then measure it using a multimeter or clamp meter set to AC amps (RMS). Allow plenty of headroom on the max loadings and be aware that the current drawn by a load is dependant on its environment. For example a pump's current is dependant on the mains supply voltage, connected pipe work, pressure (head of water), temperature etc.

Power		Current
kW	hp	A
0.5	0.7	2.1
1.0	1.3	4.2
1.5	2.0	6.3
2.0	2.7	8.3
2.5	3.4	10.4
3.0	4.0	12.5
3.5	4.7	14.6
4.0	5.4	16.7
4.5	6.0	18.8
5.0	6.7	20.8
5.5	7.4	22.9
6.0	8.0	25.0

Power		Current
hp	kW	A
0.5	0.4	1.6
1.0	0.7	3.1
1.5	1.1	4.7
2.0	1.5	6.2
2.5	1.9	7.8
3.0	2.2	9.3
3.5	2.6	10.9
4.0	3.0	12.4
4.5	3.4	14.0
5.0	3.7	15.5
5.5	4.1	17.1
6.0	4.5	18.6

Example

SP600AC20TZ – 2.0kW element, 1.5hp (electric power) pump, 1100W blower (Aux), 0.5A circulation pump, 0.1A ozone unit.

Looking at the table below it is clear that the unit will draw a maximum of 18.3A without load shedding and 13.6A with load shedding making this unit a 15A system. Note that it is important to measure the unit once in place to check the calculations and setup of the unit.

SP600 total loading calculations – 'A' models.

Dip switches																					
2 spd pump		0 (single speed)					0 (single speed)					0 (single speed)					0 (single speed)				
Load shedding		0 (none)					1 (aux AND pump(L))					0 (none)					1 (aux AND pump(L))				
circ		0 (none)					0 (none)					1 (fitted)					1 (fitted)				
Loads connected																					
Heater		1					1					1					1				
Pump (L)		1					1					1					1				
Aux / Pump(H)		1					1					1					1				
SPVCL		1					1					1					1				
Circ pump												1					1				
Ozone		1					1					1					1				
Mode		Auto	Pump on	Aux on	Pump & Aux	Pump, Aux SPVCL	Auto	Pump on	Aux on	Pump & Aux	Pump, Aux SPVCL	Auto	Pump on	Aux on	Pump & Aux	Pump, Aux, SPVCL	Auto	Pump on	Aux on	Pump & Aux	Pump, Aux, SPVCL
Load current	(A)																				
Pump (L)	4.7	4.7	4.7		4.7	4.7	4.7	4.7		4.7	4.7		4.7		4.7	4.7		4.7		4.7	4.7
Aux / Pump(H)	4.7			4.7	4.7	4.7			4.7	4.7	4.7			4.7	4.7	8.3			4.7	4.7	4.7
Heater	8.3	8.3	8.3		8.3		8.3	8.3				8.3	8.3	8.3	8.3		8.3	8.3	8.3		
Circ pump	0.5											0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Ozone	0.1	0.1	0.1		0.1	0.1	0.1	0.1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total load		13.1	13.1	4.7	17.8	9.5	13.1	13.1	4.7	9.5	9.5	8.9	13.6	13.6	18.3	13.6	8.9	13.6	13.6	10	10

6 Diagnostics

The SP600 controller has extensive self-diagnostic capabilities. In the event of a problem it will sound an alarm and indicate an error number according to the nature of the problem. Pushing the Light button will mute the alarm. The alarm will also stop after four minutes.

The error numbers and their meanings are listed below.

Error 1 (H2O) = PRIME FAILED
This is a special case in that it is not a latching error. It is not necessarily a problem with the SP600 itself but indicates that no water is being detected in the heater. A push of the pump button will run the circulation pump for one minute ('C' models) or 10s ('A' & 'B' models) to try to get water to the heater. If successful normal operation will resume. If unsuccessful Error 1 (H20) will be indicated again.

- *Check valves are open correctly, pumps are working and that there is enough water flow through the heater tube.*
- *Check that air is not trapped in the heater tube. See the 'Circulation Pump' section.*
- *Check for leaks (water or air) in pipework, O-rings, seals and loose fittings. If there is air around the water sensor the controller will think the heater is empty. This will occur if there is a small leak so that the water drains out of the heater over time.*
- *If there is water flow then the water sensor may be dirty or faulty. Remove it and inspect, replace if necessary. Check the water sensor to circuit board connection for water, corrosion or fouling.*
- *When all other options have been exhausted change the circuit board.*

Error 2 is not used.

Errors 3-8 are latching errors.
Operation will stop and will not continue until the controller is reset (switched off and on again at the main power supply).

Error 3 = STUCK BUTTON
This error indicates that one of the buttons in the control panel is stuck or has been held down for more than one minute. This may be caused by water getting into the panel or by damage to the control panel or its cable.

- *Inspect the control panel for damage, test the operation of each button by checking that they all feel the same.*
- *Check the control panel to main circuit board connection and the cable itself for any damage or corrosion.*
- *Disconnect the control panel and run the controller for one minute. If it cuts out on Error 3, then the problem is in the controller.*
- *When all other options have been exhausted change the main circuit board.*

Error 4 = NO WATER SENSOR
This error indicates a problem with the optical water sensor in the heater. It may be caused by the sensor being disconnected or by damage to the sensor.

- *Check the water sensor to circuit board connection for water, corrosion or fouling.*
- *Remove the water sensor and inspect, replace if necessary.*
- *When all other options have been exhausted change the circuit board.*

Error 5 = OVERTEMPERATURE

This error indicates that the digital temperature sensor in the heater or pool has detected a temperature of 45°C or more. This is not necessarily a problem with the SP600 itself. It might be caused by excessive pump use during hot weather. In this case reduce the filtration time set and increase the sleep time.

- *Check that another source of heat is not heating the pool excessively. Look at pumps operating for long durations, solar heating, heat pumps, lighting etc.*
- *Check that the ambient temperature is not above or close to 45°C.*
- *If an in heater temperature sensor is used check that there is adequate water flow trough the heater. Check that the filter and pump are not blocked and that the jets and valves are open.*
- *Measure the pool temperature and verify the controller's reading. If the controller has an in heater sensor then circulate the water for a few minutes first. If the controller is reading an incorrect temperature then the temperature sensor may be damaged or faulty. Connect another sensor and check that the controller is operating correctly. If it is then change the temperature sensor, if not change the circuit board.*

Error 6 = THERMAL CUTOUT TRIPPED

This error indicates that the safety electromechanical over temperature cutout on the heater has operated. This is not necessarily a problem with the SP600 itself. It may have been caused by high temperatures during shipping or by disconnection or failure of the pump. Waiting for the heater to cool below about 38°C and switching the power off and on again will clear this error.

- *Check valves are open correctly, pumps are working and that there is adequate water flow through the heater tube.*
- *Check that filters are clean and jets are open.*
- *Check thermal cutouts in pumps and other equipment. (Run pump directly from mains to see if it over heats and cuts out.)*
- *Check all connections in the controller are tight and clean.*
- *Make sure air cannot collect in the heater tube. Refer to the 'Circulation pumps' and/or 'Ozone' sections of this manual when using these systems.*
- *When all options have been exhausted change the circuit board.*

Error 7 = STUCK RELAY

This error indicates a problem with the heater control circuitry inside the unit.

- *Check that there are no short circuits across the relay terminals or associated wiring.*
- *Check that all internal wiring is correct and that terminals are tight and clean.*
- *When all options have been exhausted change the circuit board.*

Error 8 = NO TEMPERATURE DATA

This error indicates a problem with the digital temperature sensor in the heater or pool. It might be caused by the sensor being disconnected, by both the heater and pool sensors being connected, or by damage to the sensor or its cable.

- *Make sure there is only one sensor plugged into the circuit board. Either 'in-heater' or 'in-pool' sensor not both.*
- *Check the temperature sensor to circuit board connection for water, corrosion or fouling.*
- Connect another sensor and check that the controller is operating correctly. If it is then change the temperature sensor, if not change the circuit board.

7 Trouble shooting

1) The clock won't keep time.
- *Check that the power is always connected to the SP600.*
- *Check the clock is plugged into the SP600 PCB and check the connection for corrosion.*
- *The clock is faulty and needs to be returned for service.*

2) The thermal cutout keeps operating.
- *Check that there is adequate water flowing through the heater tube and that the plumbing is not blocked.*
- *Check that filters are clean and jets are open.*
- *Check thermal cutouts in pumps and other equipment.*
- *Turn the power supply to the unit off and allow the unit to cool. Turn the power back on.*
- *Check the pump is not heating the pool. A large pump running continuously will heat the pool until the power to it is cut.*
- *If a small circulation pump is in use check there is enough flow through the heater tube and that air is not collecting in the heater tube. Try to measure the flow from the circ pump outlet jet. This can be done by holding a hose on the jet's outlet and timing how long it takes to fill a bucket. Aim for more than 20 L/m. i.e. it should take no longer than 1 minute to fill a 20 litre bucket.*
- *The unit is faulty and needs to be returned for service.*

3) The unit won't power up.
- Check there is power to the unit and that the control panel is plugged in correctly.
- *Check the control panel for damage or corrosion. Try another control panel.*
- *Check all connections are correct, tight and clean.*
- *Replace the unit.*

4) The unit leaks.
- *First ascertain where the leak is.*
- *Mac-unions. Check that there are O-rings in the mac-unions. Check that the unions are tight, aligned and not distorted.*
- *Heater tube. Inspect the water sensor body for cracks and O-ring location. Tighten or replace if necessary. Tighten the element boss screws to compress the O-ring.*
- *Replace the heater tube if required.*

5) The ELCB circuit breaker keeps tripping out.
- *Check for shorts to earth and loose, dangling wires. Check the element earth leakage. Try disconnecting equipment piece by piece until you can identify what is causing the fault.*
- *Check that the ELCB is not also an overcurrent circuit breaker. If it is, make sure it is rated for motor start up surges and is not overloaded.*
- *Make sure the unit is not drawing too much current from the supply – see loading calculations.*
- *Check for damage to wiring, pumps, blowers, and lights.*
- *Check for leaks around live parts.*
- *Check earth connections.*
- *Check the supply is wired correctly.*
- *Some older switchboard ELCBs are not compatible with EMC filtered equipment and must be replaced.*
- *The ELCB may be faulty and require replacement.*

6) My pool is getting to hot.

- *Check that another source of heat is not heating the pool excessively. Look at pumps operating for long durations, solar heating, heat pumps, lighting etc.*
- *In extreme climatic conditions where there is a high ambient temperature the normal operation of the unit and pump can cause the pool to over heat. To counter this, remove the pool cover over night to allow the pool to cool. Be sure the pool is safe to leave uncovered. Consider access by children, animals etc.*
- *Increase sleep time and minimise filtration time.*

8 Part replacements

Every precaution has been taken to insure the highest quality and reliability is delivered in each SP600. However in the unlikely event that something does go wrong, it is normally a simple operation to replace the faulty section of the controller or the entire controller if necessary.

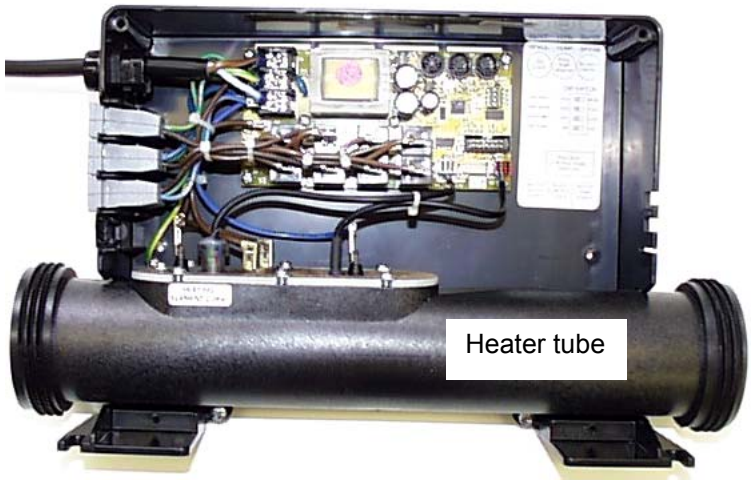
To avoid unnecessary part replacement it is important that the fault be diagnosed correctly. Refer to the diagnostics and trouble shooting sections before attempting to change any parts. Only authorised service agents should attempt to change parts.

Most problems are caused by something obvious so remember to check the obvious first - connections, power supply, pumps, water flow, and leaks…

Refer to the correct wiring diagram for the model that you have when checking connections.

8.1 Heater tube

<u>Removal</u>
Turn the power to the unit off at the supply. Close the water valves so that the unit can be disconnected without draining the pool or causing a flood. Loosen the locking rings on the mac-unions and disconnect pipe work (don't loose the O-rings). Note the connections in the unit so that they may be disconnected and reconnected later on.



Disconnect the heater tube wiring using a pair of pliers to grip each terminal in turn– don't pull on the wire itself. Disconnect the two wires from the thermal cut out, disconnect the earth wire, disconnect the element phase and neutral wires and unplug the water sensor and temperature sensor. Unscrew the two mounting screws that locate the heater tube in place so that it can be removed.

Installation
Installation is the reverse of removal, but remember to soak up any water in the unit. Check the replacement element is the same rating as the old one and check the connections are correct and tight. (Refer to the appropriate wiring diagram) Turn the water back on, bleed air from pipe work and then turn the power on. Check the operation of the unit and check for leaks.

8.2 Water sensor

Removal
Turn the power to the unit off at the supply. Isolate the water supply and drain the heater tube so that the water sensor can be removed without draining the pool or causing a flood. Cut the cable ties on the sensor's leads and disconnect the plug from the circuit board. Unscrew the sensor from the element boss.

Installation
Lubricate the water sensor O-ring with a little silicon grease if it is not already lubricated. Slide the O-ring over the water sensor and screw the water sensor into the element boss until the O-ring is seated inside the recess and the sensor body starts to tighten up on the O-ring or boss. Then back the sensor off ¼ of a turn. This will insure that the water sensor's body is not in contact with the element boss and is not under too much tension. If the water sensor is over tightened or it's body is hard up against the element boss it will crack and leak.

Plug the sensor into the circuit board and cable tie the leads into place. Soak up any water in the unit, reconnect the water, bleed air from pipe work and reconnect power supplies. Check the operation of the unit and check for leaks.

8.3 Circuit board

Removal
Turn the power to the unit off at the supply. Note where each wire is connected on the circuit board and relays. Disconnect all wires, the cable ties will hold the wires in position for reassembly so don't cut them. When disconnecting terminals, use a pair of pliers to grip the terminals, not the wire, and then pull the terminal off.

Taking anti-static precautions.

The main anti-static precaution to take is to make sure your body is at the same electric potential as the circuit board. To do this **first disconnect the power**, then touch the neutral terminal on the mains terminal block. Now you can handle the circuit board.

Remove all of the six screws that hold the circuit board to the housing and lift the circuit board out of the unit.

Installation

Taking antistatic precautions as above, screw the circuit board into place using the six screws. Reconnect all wires and check that all connections are correct and tight. (Refer to the appropriate wiring diagram) Turn the power to the unit back on.

Reset the set temperature and filtration as desired. If a new circuit board is fitted, check the dipswitches are set correctly.

9 Frequently asked questions

1) Can I make it load shed?

Yes, refer to the dipswitch settings information in the installation guide for your model – see the appendix.

2) Can I mount the SP600 on it's side.

Yes, the SP600 can be mounted so that it's heater tube is vertical with the water senor at the top. The water must flow from the bottom of the tube to the top. This will force out all air in the tube. Note that an in pool temperature sensor is recommended in this configuration, especially if a small circulation pump is used.

3) Can I mount the SP600 on it's back / front / upside down.

No, any of these mounting positions will cause the water detection system to operate incorrectly.

4) Can I run a standard incandescent pool light from the SP600.

Yes, but it must be used with a separate transformer and controlled by the Aux outlet.

10 Warranty information

SPA-QUIP product warranty for Australia and New Zealand.

The Spa-Quip warranty is very simple and is designed to protect your purchase over the first two years, as follows. The first 12 months after purchase there is a full in-field warranty cover on faulty parts or workmanship. Over the following 12 months there is a bench warranty. The product must be returned, freight paid, to Spa-Quip where it will be repaired at no cost and returned to you free of charge. A bench warranty does not include the cost of local service people to remove or re-install the equipment.

Terms and conditions.

1 This warranty applies to all states and territories of Australia and New Zealand only and is subject to the provisions of the Trade Practices Act (Aust), the Goods and Consumer Protection Legislation of the various Australian states and the Consumers Guarantee Act 1993 (NZ) as applicable.

2 The warranty period commences on the date of original purchase of the equipment. Evidence of this date of original purchase must be provided when claiming repairs under warranty. It is recommended you retain all receipts in a safe place as failure to provide proof of purchase will result in warranty being refused.

3 This warranty is subject to due compliance by the original purchaser with all directions and conditions set out in the installation and Operating Instructions. Failure to comply with these instructions, damage or breakdown caused by fair wear and tear, negligence, misuse, incorrect installation, water in the control enclosure or element, chemical or additives in the water, inadequate protection against freezing, rain or other adverse weather conditions, corrosive or abrasive water, lightning or high voltage spikes or though unauthorised persons attempting repairs are not covered by this warranty. The product must only be connected to the voltage shown on the nameplate and with a correctly rated cable.

4 Without limiting the original purchaser’s entitlement under the Trade Practices Act (Aust), the Goods and Consumer Protection Legislation of the various Australian states or the Consumers Guarantee Act 1993 (NZ), Spa-Quip shall not be liable for any loss of profits or any consequential, indirect or special loss, damage or injury of any kind whatsoever arising directly or indirectly from the product or defect.

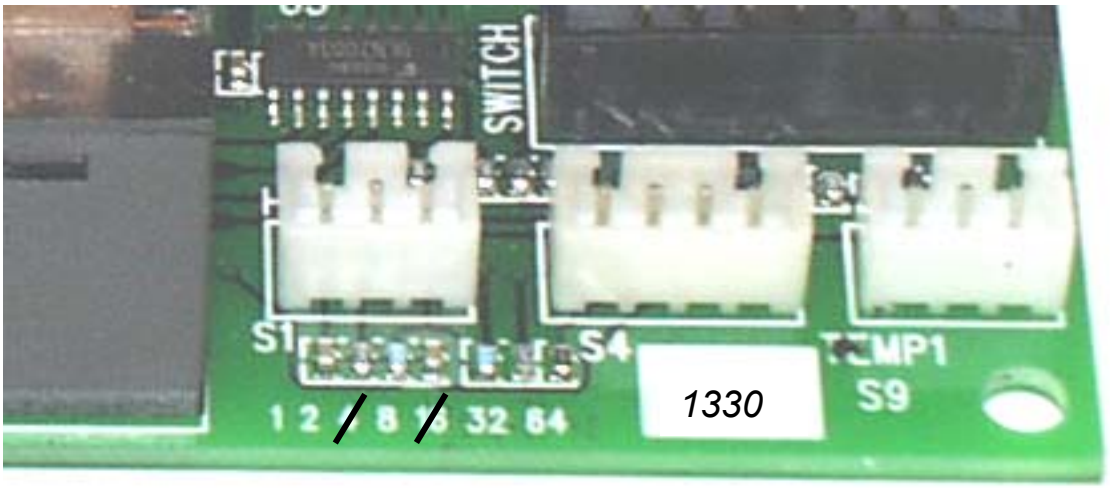
5 Replaceable, wearing items such as pump seals, filter cartridges, light bulbs etc. are not covered by this warranty.

6 Equipment used for working displays or demonstration is not covered by this warranty.

11 Identification

Each SP600 has a unique serial number, it is attached next to the circuit board and on the unit's lid label.

The PCB also has a version number, job number and software version number. The job number is hand written and the software version number is found by adding up the crossed out numbers. For example in the picture the job number is 1330 and the numbers 4 and 16 have been crossed out indicating the software version is 20.



Software version Job number

The element power rating is identified by a sticker on the side of the heater tube and is also stamped into the element boss.

12 Part numbers for spares ordering

Description	Part number
Digital sleep clock	921011
SPVCL	3703
SPVSB	5602
Heater tube element assembly 1.5kW	949423
Heater tube element assembly 2.0kW	949424
SP600 controller circuit board, all models	846601
SP600 switch, all models	71092
Water sensor	915441A
In-pool temperature sensor	915443
Wiring harnesses	Same as drawing number.

13 Contact details

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